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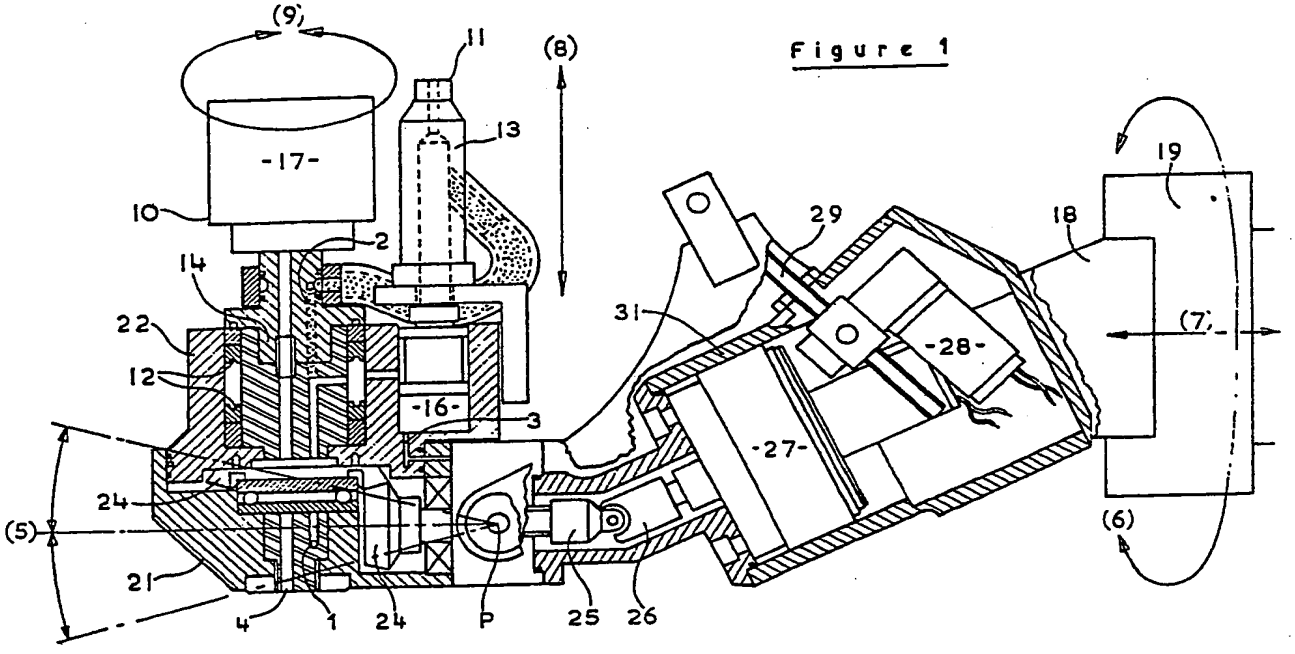
GB 2192442 A

(58) Field of search
UK CL (Edition K) B3D DBB DBG DBH, F2P PG1
INT CL[5] B24C, B26F

(54) High pressure rotary cutting tool

(57) A power driven rotary cutting tool is adapted for in-use control remote from the tool's cutting head, and intended for use in areas – for example, inside pipelines and other tubular components – where the degrees of freedom of movement of the cutting head are relatively restricted, the cutting action of the tool being derived from a jet or jets issuing at high pressure from the cutting head and impinging against the workface as the cutting head rotates. The jet (or at least one of the jets if there are more than one) comprises a mixture of media one at least of which is an inherently abrasive particulate medium (for example, sand) and which are supplied separately to the head and then caused to mix as or before they strike the workface, and the jet media is conducted from the point where they enter the head, through the head and towards the jet nozzle 11, by galleries 1, 2 formed inside the head.

Figure 1



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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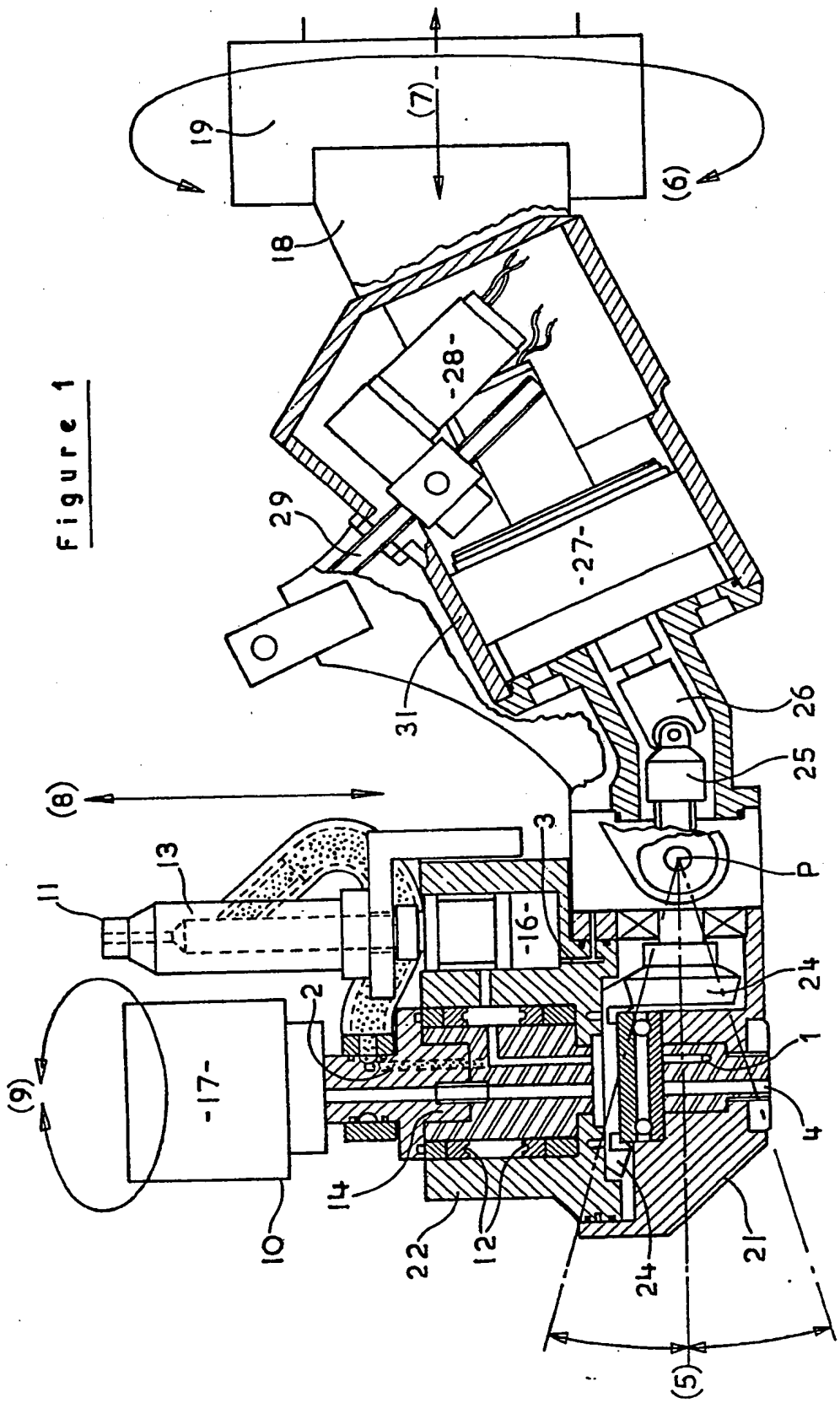

Figure 1

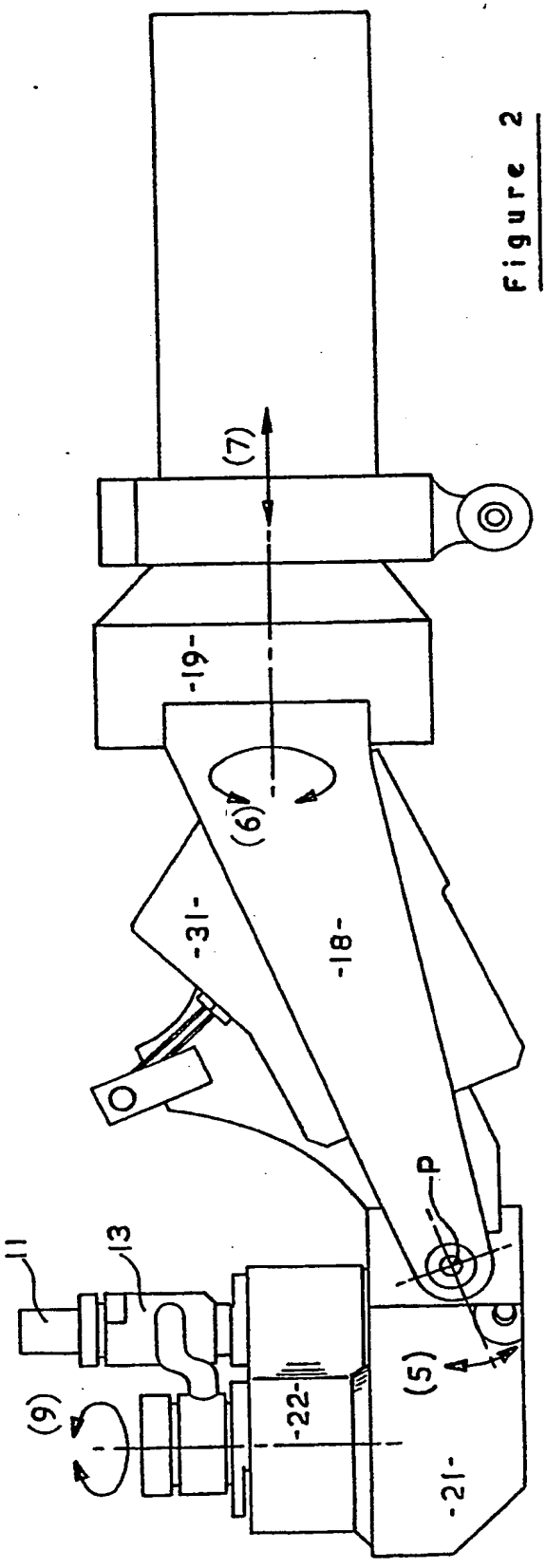

Figure 2

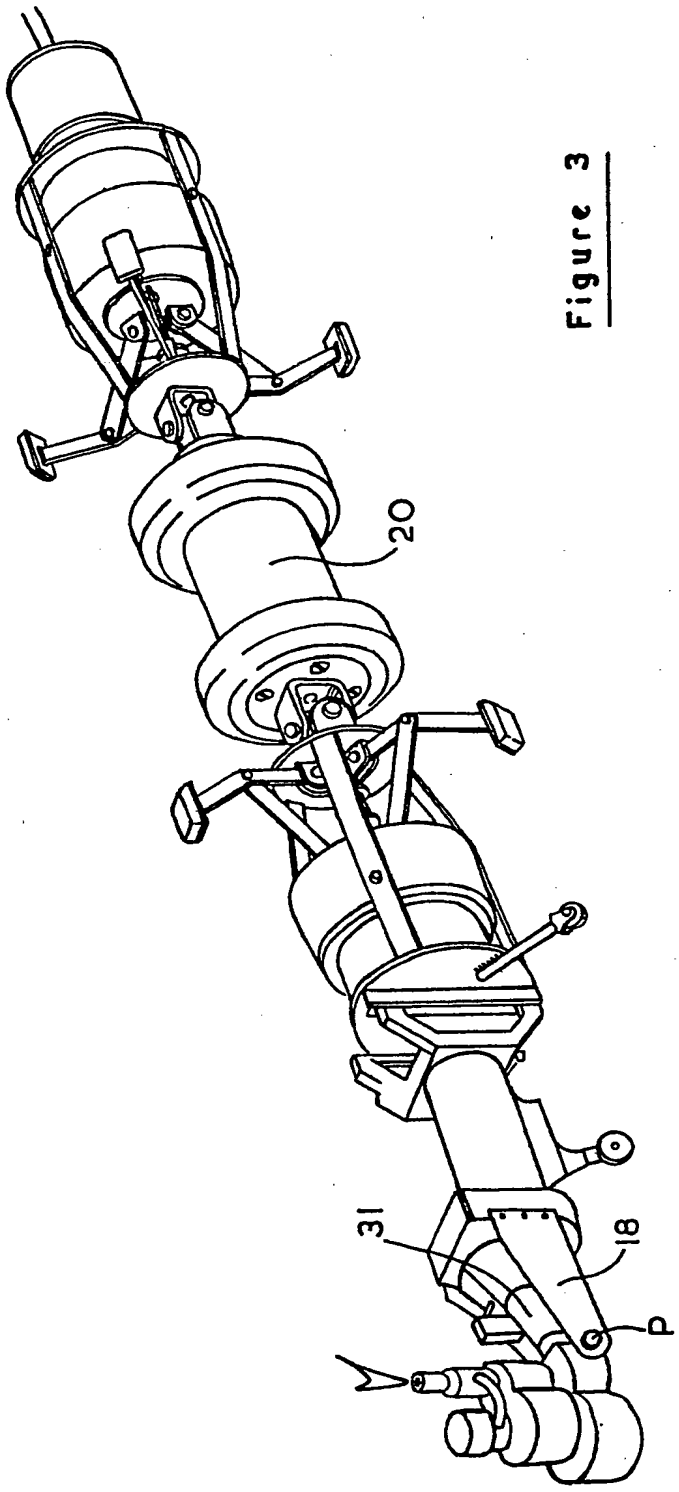

Figure 3

HIGH PRESSURE ROTARY CUTTING TOOL

Background to the Invention

The invention relates to the use of a cutting tool, for example a high pressure rotary cutting tool, in restrictive areas, for example tubular assemblies and pipe lines, and to activating and instructing such an implement. Although the invention will be described in relation to a high pressure rotary cutting tool, it will be clear that the invention is applicable to other kinds of cutting tool.

It is often found that incoming or outgoing feedlines to the main pipe line section do not present a 90^{o} angle to the longitudinal axis of the main section. This problem is also found with node members which, likewise, frequently do not present a 90^{o} angle to the longitudinal axis of the main section. In each case, feedlines and node members may both be angled at variable degrees to the longitudinal axis of the main section and, additionally, their position may vary in a circumferential plane.

Currently, the cutting tools used within restricted areas, such as tubular assemblies and pipe lines, have external hoses to supply the cutting nozzle. The disadvantages of having these loose and restrictive hoses is that they are likely to become entangled or damaged due to continuous rotation of the cutting head.

The object of this invention is to provide a high pressure rotary cutting head which is remotely controlled and which presents cutting nozzles to the "work face" using, for example, water and grit mediums, these mediums being supplied to the cutting nozzle by internal galleries.

The invention, when used in relation to cutting materials in restrictive areas, provides both an accurate remote control and adjustment of the necessary angles of tool presentation and operation, without peripheral encumbrances, so that the invention has controlled freedom of movement in three planes and allows the positioning of the cutting head in three planes. This results in an accurate, expeditious and rapid cutting of materials.

Summary of the Invention

The scope of the present invention is defined in the claims ending and forming part of this specification.

Brief Description of the Drawings

The invention will now be described, by way of example only and with reference to the accompanying drawings, in which:

Figure 1 is a sectional view of a high pressure rotary cutting tool embodying the invention;

Figure 2 is a side view of the high pressure rotary cutting tool embodying the invention;

Figure 3 is a perspective view of the high pressure rotary cutting tool when connected to a traction unit.

Description of the Preferred Embodiment

This embodiment of a high pressure rotary cutting tool can execute precision circular cutting in tubular assemblies, pipe lines and other restricted areas, above and below ground.

Referring to Figure 1, a high pressure rotary cutting head has four galleries, 1, 2, 3 and 4 which supply cutting nozzle 11.

Gallery 1 receives water at high pressure, for example 6,000-10,000 psi from a water pump cited at a point remote from the high pressure rotary cutting tool. Gallery 1 contains high pressure seals 12 and permits water supply through a 360^{o} rotation to a jet 13 of a pre-determined size to the cutting nozzle 11.

The diameter to be cut by the nozzle 11 is set, together with a fixed radius from a central gallery support column 14.

Gallery 2 receives a medium in a dry state, for example grit, from a surface hopper, via a hose (not shown) at approximately 50 psi. The surface hopper is situated at a point remote from the high pressure rotary cutting tool. Before entering gallery 2, the grit passes through an expansion chamber (N/S)which allows pressure to escape to atmosphere. The grit is transported through gallery 2 by the effect of the high pressure water passing through jets 13 and sucking the grit into the water jet stream.

Gallery 3 provides compressed air to a holder housing 16 and jet assembly 13. The holder 16 acts as a pneumatic piston and cylinder assembly and this assembly is used to adjust the position of the cutting nozzle 11, relative to the profile of the tubular being cut.

Gallery 4 allows the free transition of electrical services to sensors 17 which position and locate the high pressure rotary cutting tool, the sensors being located at the head of the unit.

A control assembly 5, for example electrically or mechanically controlled, allows the cutting nozzle 11 to be controlled perpendicular to the longitudinal axis of the main section of tubular or pipe. The assembly 5 controls the tilt of the cutting nozzle 11, forwards or backwards, as shown by arrow "7".

A control assembly 6, which can either be electrically or mechanically run, allows the cutting nozzle 11 to move in a radial circumferential plane.

Referring now to Figures 2 and 3. The alignment of the high pressure rotary cutting tool, together with the cutting nozzle 11, along the longitudinal axis of the main tubular assembly or pipe line section, to either a feedline or a node position, is effected using the traction vehicle unit 20. This unit causes the high pressure rotary cutting tool to be moved forwards or backwards. The traction vehicle unit 20 includes a rotate motor and tilt motor assembly 21.

Referring again to Figure 1. The high pressure rotary cutting tool incorporates a system 8, a pneumatic profile follower, to ensure that the cutting nozzle 11 accurately follows the profile of the area being cut, as the cutting nozzle 11 rotates in a circular plan 9, relative to the longitudinal axis of the main section of tubular assembly or pipe line.

The high pressure rotary cutting tool is remotely operated by manual actuation from a unit controlling any or all of the nodes and functions described above. In addition, the cutting tool can be remotely controlled, without manual intervention, by using analogue feedback from a location/positioning system 10, via a remote micro processor,

in either a driver or closed servo loop mode, to the electrical or mechanical actuators.

The U-shaped arm 18, fixed to a gearbox drive assembly 19, is the arm which rotates in the sense indicated by arrow 6. This same arm holds the gallery assembly 21, the rotating cutting head ring 22 which carries the nozzle 13 round with it, and the central stationary gallery column 14 about which the head ring 22 and nozzle 13 are driven via a bevel pair 24 transmitting the drive through universally jointed shafts 25, 26 which take power from a geared motor unit 27. A second geared motor unit 28 drives a screw drive 29 to tilt the assembly 21, 22, 14 about pivot P through whose axis the assembly is secured to arm 18. Both motor units 27 and 28, and their drives, are housed in a casing 31 which forms an extension of gallery assembly 21 and which moves about pivot P with that assembly.

CLAIMS:

1. A power driven rotary cutting tool, adapted for in-use control remote from the tool's cutting head, and intended for use in areas - for example, inside pipelines and other tubular components - where the degrees of freedom of movement of the cutting head are relatively restricted; the cutting action of the tool being derived from a jet or jets issuing at high pressure from the cutting head and impinging against the workface as the cutting head rotates; the jet (or at least one of the jets if there are more than one) comprising a mixture of media one at least of which is an inherently abrasive particulate medium (for example, sand) and which are supplied separately to the head and then caused to mix as or before they strike the workface; and the jet media being conducted from the point where they enter the head, through the head and towards the jet nozzle, by galleries formed inside the head.

2. A tool according to Claim 1 and in which the jet media mix by entrainment before or as they leave the jet nozzle.

3. A tool according to Claim 1 or Claim 2 and in which the cutting head is adapted to have three degrees of freedom of movement.

4. A tool according to Claim 3 and in which the head is adapted to advance and retreat, generally across the jet direction; to tilt, generally either side of the jet direction; and to rotate, wholly or partially, generally about its axis of advance and retreat.

5. A tool according to any of the preceding Claims and in which the head also includes a gallery, for any necessary electrical services, within the head.

6. A cutting tool substantially as described herein with reference to and as illustrated in the accompanying drawings.

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(Translation of a statement from the Norwegian Patent Office dated 2003.05.20.)

Office Action regarding patent application 20025708. PLEASE NOTE THAT CORRECT APPLICATION NUMBER IS 2002 5798.

Conclusion
It is not yet possible to decide whether the application may lead to a patent.

Results of the novelty search
In order to illustrate the state of the art, attention is drawn to the following documents:
D1: GB 2 236 065
D2: US 5,381,631
D3: US 5,765,756

Assessment of patentability
Novelty
D1 is considered to be the closest prior art. This document shows a cutting tool for downhole use, comprising a cutting nozzle where an abrasive material is added to the cutting fluid and where the nozzle may be raised/lowered and horizontally translated, as well as rotated about three axes. The movement of the tool is sensor-/computer- controlled and hydraulically-/electrically activated.

D2 shows a cutting tool for down hole use where the axial and rotational position in the drill hole may be adjusted. The position of the tool is controlled by the help of measurment transducers.

D3 shows a tool for downhole window cutting by the use of a cutting nozzle where an abrasive material is added to the cutting fluid. The tool may be raised/lowered as well as rotated about the longitudinal axis of the tool.

The device according to the independent claim 1 is considered to be known from all of the cited documents, while the method according to the independent claim 5 is considered to be known from D1.

Inventive step
The subject matter of the application, as lied out in the independent claims is not new, and does not contain an inventive step.

Formal shortcomings
The independent claim 1 does not include all features that is needed in order to achieve the intended effect, cf. PB § 3-2. It is also unclear what is meant by the term "work area".

Claims 2 and 5 mention design features in definite form, even though the features are not previously mentioned, cf. pencil remarks in doc. Nº 1b.

Instruction

The subject matter of the application must be defined more precisely with regard to prior art, and the formal shortcomings must be rectified. A new set of claims must be submitted.